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The dynamic impacts of financial institutions on economic growth: Evidence from the European Union

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This paper investigates the dynamic impacts of financial institutions on economic growth based on a panel data set comprised of 13 countries in European Union (EU) over the period of 1976–2005. We found several important results. First, there exists a long-run equilibrium relationship among banking development, stock market development and economic development, and stock market capitalization and liquidity have positive long-run effects on economic development. Second, financial depth may have a negative long-run effect on real output, but improving risk diversification and information services of commercial banks results in stable economic development. Finally, stock market liquidity has a negative short-term influence on economic growth.

1. Introduction

Is there a long-run equilibrium relationship among credit markets, equity markets and economic development? What are the short-run effects of equity markets and/or credit markets on economic growth? Do the long- and short-run effects of financial institutions on the economy behave differently? To answer these questions, we set up a panel error-correction model and then apply the panel mean group (PMG) estimators of Pesaran et al. (1999) to examine the long-run and short-run effects of credit and stock market development on economic activity.

The explosive growth of equity markets around the world has recently opened a new avenue of research into the issue of a finance-growth nexus. Several studies have highlighted the importance of equity markets, in addition to credit markets, even though equity issuance is a relatively minor source of funds (Levine and Zervos, 1998; Rousseau and Wachtel, 2000). Stock market plays at least two important functions to enhance economic growth. First, it allows investors' financial portfolios to be altered with low transaction costs and making financial traded assets less risky (Levine, 1991; Bencivenga

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et al., 1996); further, it provides an exit mechanism for both investors and entrepreneurs and improves the efficiency of financial intermediation (Rousseau and Wachtel, 2000; Arestis et al., 2001).

Past theoretical contributions have featured one of two possible sources of external finance in the form of debt, typically a bank loan, (Greenwood and Jovanovic, 1990; Bencivenga and Smith, 1991) or equity (Levine, 1991; Bencivenga et al., 1995) but not both. Yet it is difficult to identify the impact of credit and stock markets on economic growth, unless both markets are taken into account (Beck and Levine, 2004). In addition, omitting stock market development makes it difficult to justify whether a positive long-run impact of banking development on economic development holds when stock market development is taken into account (Beck and Levine, 2004).

The current global financial crisis, beginning in the middle of 2007, indicates the close interaction between bank and equity markets on the economy. The recent financial crisis began with reversals of the housing boom and high default rates on sub-prime mortgages. The crisis was initiated by expansionary monetary policy exacerbating the loose lending standard (Ashcraft and Schuermann, 2008; Dell'Ariccia et al., 2008). Excess expansionary monetary policy causes interest rates to historically low levels, which encourages investors to invest in housing markets, especially in the sub-prime mortgage market.[1] Securitization is believed to improve the efficiency and liquidity of credit market.[2] However, the securitization process allows banks off-load their default risk to the buyers of securities in a capital market, which not only deepen adverse selection problems and moral hazard incentives that adheres to the loan market but also strengthen the connection of the banking industry and capital market.[3] The interlinked investment between sub-prime mortgage and securitization exacerbated the crisis and led to its global scale. The experience of the recent financial crisis points out the importance of the interaction between credit and equity markets on economic activities. Therefore, it is crucial to allow both credit and equity markets in the model and then investigate the dynamic impact of financial institutions on economic growth.

Large numbers of related literature have empirically investigated the role of financial development in the process of economic growth. Among these studies, there is no general consensus about the role of either credit or equity markets on economic growth.[4] In addition, some articles investigate the long-run and short-run effects of financial institutions on economic growth based on vector error-correction models (VECM) of a single country (e.g., Rousseau and Wachtel, 1998; Luintel and Khan, 1999; Arestis et al., 2001; Al-Yousif, 2002; Hondroyiannis et al., 2005). These results provide only local evidence for some specific countries. To take into account cross-sectional information from other countries, Calderon and Liu (2003), Christopoulos and Tsionas (2004), and Loayza and Ranciere (2006) apply a panel data analysis, however, they neglect the crucial role of stock markets.

This paper investigates the dynamic influence of financial institutions on economic growth based on a panel data set comprised of 13 EU countries. We adopt an autoregressive distributed lag (ARDL) model of Pesaran et al. (1999) to examine the long- and short-run effects of financial institutions on growth. We found several interesting results. First, there exists a long-run relationship between banking development, stock market development and economic development. Second, stock market development has positive long-run consequences on real output, highlighting the importance of equity markets in the process of economic development. Third, financial depth may have a negative long-run outgrowth on real output, but improving risk diversification and information services of commercial banks results in stable economic development. Finally, stock market liquidity has a negative short-term effect on economic growth. Our findings of positive long-run but negative short-run consequences of financial institutions on economic growth support theoretical implications posted by Wynne (2002) and Dell'Ariccia and Marquez (2004, 2006).

The organization of the paper is given as follows. Section 2 provides a simple theoretical model to analyze the long-run impact of financial institutions on economic growth. Section 3 describes our empirical methods including the panel unit-root tests of Pesaran (2007), the pooled mean group (PMG) estimation provided by Pesaran et al. (1999), and the impulse response function construction suggested by Pesaran and Shin (1996, 1998), Pesaran et al. (2000). The empirical results of the paper are discussed in Section 4. Finally, some concluding remarks are offered in Section 5.

2. The model

We provide a simple endogenous growth model to capture the potential effects of financial institutions, i.e., credit and equity markets, on growth, which is modified from Pagano (1993). Assuming that firms produce outputs with capital having the following constant return to scale representation:

[1] A sub-prime mortgage is a type of loan granted to individuals with lower credit ratings.

[2] Securitization is the process of taking an illiquid asset, or group of assets, and through financial engineering, transforming them into a security. These derivative securitization products are sold to investors over the world, especially to the European market.

[3] When the risky underlying sub-prime mortgages default, investors holding securities, such as Mortgage-Backed Securities (MBSs) or Collateralized Debt Obligation (CDOs), suffered significant losses, investors (lenders) around the world start to take back their money due to the lack of confidence, but investment banks had little deposits because the financial institutions who involved themselves in MBS or CDO faced a massive asset write-down. Ultimately, financial institutions meltdown dramatically and investors redeemed assets from various mutual funds, which resulted in significant decline of stock market in many countries.

[4] Some articles document that financial development results in economic growth (King and Levine, 1993; Levine and Zervos, 1998; Levine et al., 2000; Beck et al., 2000; Arestis et al., 2001; Beck and Levine, 2004), but others do not (Atje and Jovanovic, 1993; De Gregorio and Guidotti, 1995; Ram, 1999). With respect to the linkage between equity markets and growth, some articles support the positive role of equity markets on economic growth (Atje and Jovanovic, 1993; Levine and Zervos, 1998; Beck and Levine, 2004). Others find a weak relationship between stock markets and economic development (Harris, 1997; Arestis et al., 2001).

$$Y_t = AK_t, \tag{1}$$

where Y_t, K_t, and A denote output, capital stocks and the social marginal productivity of capital, respectively. The aggregate capital stock can be seen as a composite of physical and human capital (Lucas, 1988). Assuming that the economy produces a single good that can be invested or consumed, the gross investment, I_t, is defined as follows:

$$I_t = K_{t+1} - (1-\delta)K_t, \tag{2}$$

where δ denotes a constant depreciation rate.

According to the related theories of capital structure, investment must be financed with debts, equity, or both. Pecking order theory[5] mentions that firms' priorities on the source of funds for investment is retained earnings (internal finance), external debts (typically bank loans), and external equity financing (Myers, 1984, and Myers and Majelf, 1984). On the other hand, the static tradeoff theory of cooperate financing is built around the concept of target capital structure that balances various costs and benefits of debts and equity (Modigliani and Miller, 1963; Jensen and Meckling, 1976; Myers, 1977).[6] That is, except for internal finance, financial intermediations and stock markets are two other sources of funds for firms to finance their investment. Frank and Goyal (2003) finds that external finance plays a significant role in financing firms' investments. Accordingly, we assume that investment is financed through funds from credit and equity markets and that these two sources of funds interact to each other with the following constant elasticity of substitution (CES) function:

$$I_t = \mathrm{SF}_t(\mathrm{CD}_t, \mathrm{SM}_t) = \left[\alpha \mathrm{CD}_t^\rho + \beta \mathrm{SM}_t^\rho\right]^{\frac{1}{\rho}}, \tag{3}$$

where CD_t and SM_t represent the sources of funds obtained from financial intermediations and stock markets, respectively.

The source of funds obtained from financial intermediations is assumed to be a constant proportion of saving (S_t), i.e., $\mathrm{FD}_t = \phi S_t$. Thereby, Eq. (3) can be expressed as

$$I_t = \left[\alpha(\phi S_t)^\rho + \beta(\mathrm{SM}_t)^\rho\right]^{\frac{1}{\rho}}. \tag{4}$$

After simple manipulation from Eqs. (1) to (4), the output growth rate can be written as

$$g_{t+1} = A\frac{I_t}{Y_t} - \delta = A\frac{\left[\alpha(\phi S_t)^\rho + \beta(\mathrm{SM}_t)^\rho\right]^{\frac{1}{\rho}}}{Y_t} - \delta, \tag{5}$$

The steady-state growth of output is

$$g = A\left[\alpha(\phi s_1)^\rho + \beta(s_2)^\rho\right]^{1/\rho} - \delta, \tag{6}$$

where $s_1 = S/Y$ and $s_2 = \mathrm{SM}/Y$ denote steady-state saving ratio and the ratio of equity to output, respectively. An important implication of Eq. (6) is that both stock and credit market development affect economic growth. In other words, the effects of stock market development on the economy should not be ignored in empirical investigation.

3. Empirical methodology

3.1. Unit-root tests

Before examining the existence of a long-run relationship among variables, we examine the stationarity of variables using the panel unit-root test of Pesaran (2007). This test is attractive since it allows for cross-sectional dependence which is neglected in conventional panel unit-root tests such as Im et al. (2003). To justify the existence of contemporaneous correlation across individuals in the panel, we apply the cross-sectional dependence (CD) test developed by Pesaran (2004) to examine the null hypothesis of cross-sectional independence among individuals in the panel:

$$\mathrm{CD} = \left[\frac{TN(N-1)}{2}\right]^{1/2}\bar{\hat{\rho}},$$

where $\bar{\hat{\rho}} = \left(\frac{2}{N(N-1)}\right)\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}$, in which $\hat{\rho}_{ij}$ is the pair-wise, cross-sectional correlation coefficients of residuals from the conventional ADF regression. T and N are sample and panel sizes, respectively.

Next, consider the following cross-sectionally augmented Dickey-Fuller (CADF) regression:

$$\Delta y_{it} = \alpha_i + \kappa_i t + \beta_i y_{it-1} + \gamma_i \bar{y}_{t-1} + \phi_i \Delta\bar{y}_t + \varepsilon_{it}, \quad t = 1,\ldots,T \quad \text{and} \quad i = 1,\ldots,N, \tag{7}$$

where $\bar{y}_t = N^{-1}\sum_{i=1}^{N} y_{it}$ is the cross-sectional mean of y_{it}. The purpose of including the cross-sectional mean in the above equation is to control for contemporaneous correlation among y_{it}. The null hypothesis of the test can be expressed as $H_0{:}\beta_i = 0$ for all i against the alternative hypothesis $H_0{:}\beta_i < 0$ for some i.

[5] Myers (1984), and Myers and Majelf (1984) contend that firms prefer retained earnings (internal finance) as their main source of funds for investment then debt-financing and last equity financing.

[6] Static tradeoff theory indicates that an increase of debts will be followed by an increase of equity to ascertain an optimal target of debts to equity ratio.

The test statistic provided by Pesaran (2007) is given by

$$\mathrm{CIPS}(N,T) = N^{-1}\sum_{i=1}^{N} t_i(N,T),$$

where $t_i(N,T)$ is the t statistic of β_i in Eq. (7). In addition, Pesaran (2007) constructs a truncated version of the CIPS, denoted by CIPS*, to avoid the problem of extreme statistic caused by small sample observations.

$$\mathrm{CIPS}^*(N,T) = N^{-1}\sum_{i=1}^{N} t_i^*(N,T),$$

where $t_i^*(N,T) = t_i(N,T)$ if $-K_1 < t_i(N,T) < K_2$, $t_i^*(N,T) = -K_1$ if $t_i(N,T) \leqslant -K_1$, and $t_i^*(N,T) = K_2$ if $t_i(N,T) \geqslant K_2$. The parameters K_1 and K_2 are positive constants based on simulations.[7] The critical values of CIPS(N, T) and CIPS*(N, T) tests are given in Table II(c) of Pesaran (2007).

3.2. The PMG method of Pesaran et al. (1999)

To estimate the long- and short-run elasticity of banking and stock markets on economic development, we set up an error-correction model and then estimate the model based on the PMG estimators provided by Pesaran et al. (1999). The major characteristic of these estimators is that it restricts the long-term coefficients to be the same, but allow the intercepts, short-run coefficients and error-correction coefficients to be country specific.

The error-correction form of an ARDL (p, q) model is written as follows:

$$\Delta Y_{i,t} = \phi_i(Y_{i,t-1} - c - \beta' X_{i,t-1}) + \sum_{k=1}^{p-1}\alpha_{ik}\Delta Y_{i,t-k} + \sum_{j=1}^{p-1}\gamma'_{ij}\Delta X_{i,t-j} + \varepsilon_{i,t}, \tag{8}$$

where X_{it}=FD$_{it}$ and STOCK$_{it}$ in which FD and STOCK are indicators of credit and stock market development, respectively; β is a vector of long-run coefficients; α_{ik} and γ_{ij} are short-run coefficients, ϕ_i is the speed of adjustment to the long-run equilibrium.

To construct the estimators, Pesaran et al. (1999) suggest estimating the long-run slope coefficients (β) jointly across agents through a maximum likelihood (MLE) approach. Once the pooled MLE of the long-run parameters is successfully computed, the short-run and error-correction coefficients can be consistently estimated by running the individual MLE. Therefore, the mean of error-correction coefficient (ϕ_{MG}) and short-run coefficients (α_{MG} or λ_{MG}) follow asymptotic normality and can be calculated by the equal weighted average of individual coefficients:

$$\phi_{\mathrm{MG}} = N^{-1}\sum_{i=1}^{N}\phi_i; \quad z_{\mathrm{MG},j} = N^{-1}\sum_{i=1}^{N} z_{ij}.$$

where $z = \alpha$ and γ.

An important assumption for the consistency of the PMG estimates is the independence of the regression residuals across countries. In practice, contemporaneous correlation across residuals arises from omitted common factors. To eliminate the influence of these common factors, we follow the conventional strategy to allow for time-specific effects in the estimated regression. This is equivalent to regressing Eq. (8) with each variable deviating from its cross-sectional mean in a particular year.

The advantages of Pesaran's method are that it provides asymptotic distribution of estimators and offers the best available in the search for consistency and efficiency irrespective of whether the regressors are all $I(0)$ or $I(1)$. There are two major requirements for the validity of this methodology. One is the existence of a long-run relationship among variables of interest; and the other one is that the regressors are strictly exogenous and the resulting residuals are serially uncorrelated.

The choice of the PMG estimators faces a general trade-off between consistency and efficiency. Imposing common long-run relationships across countries improves the efficiency of estimators if the restrictions are valid. However, if they are false then the PMG estimators are inconsistent. In such a case, the conventional mean group (MG) estimators provided by Pesaran and Smith (1995) are consistent. Therefore, the long-run homogeneity restrictions can be investigated using the Hausman test to examine if the PMG and MG estimates of long-run coefficients differ significantly.

The PMG approach appears to be a good candidate when data from EU countries are analyzed. This is because countries in the EU are highly integrated in terms of their economic and monetary structures. They have a unified market and a single central bank, the European Central Bank (ECB), and most of them have adopted a single currency (Euro). Typically, these countries adhere to various economic and monetary policies formulated by the EU, such as saving and investment policies. We therefore expect that the long-term relationship between credit market development, stock market development and economic development would be more homogenous across countries in EU. However, short-run impacts of credit and stock markets on economic activity are affected by local laws, regulations, and governments, and hence it is reasonable to argue that country heterogeneity is particularly relevant in short-run relationships.

[7] Based on Pesaran (2007), K_1 and K_2 are 6.42 and 1.70, respectively.

3.3. Impulse response analysis

To discuss the impact of different shocks on variables over time, we follow the methodology of Pesaran and Shin (1996, 1998), Pesaran et al. (2000) to construct the impulse response function (IRF) of real output, credit and equity markets, respectively. It is worth noting that one important assumption in Pesaran et al.'s (1999) ARDL model is that regressors in Eq. (8) are strictly exogenous. In other words, we assume that variables for credit and equity development are exogenous, which is implicitly imposed in existing literature (Loayza and Ranciere, 2006). Under these assumptions, the system equations of ΔY_{it} and ΔX_{it} are given as follows:

$$\Delta Y_{it} = c_i + \Lambda_i \Delta X_{it} + \Psi_i \Delta Z_{it-1} + \Pi_{iY} Z_{it-1} + u_{it} \tag{9}$$

$$\Delta X_{it} = a_{iX} + \Gamma_{iX} \Delta Z_{it-1} + e_{iXt} \tag{10}$$

where $Z_{it} = (Y_{it}, X_{i1t}, X_{i2t})'$, $X_{it} = (X_{i1t}, X_{i2t})'$, $e_{iXt} = (e\prime_{iX_1t}, e\prime_{iX_2t})\prime$. The lag order of the model in Eqs. (9) and (10) is set to one since annual data are adopted and it is straightforward to allow the lag order of the model to be greater than one. The coefficients of Eq. (9) are estimated by the PMG method of Pesaran et al. (1999)[8] and the coefficients of the vector autoregression model of (10) are estimated by least squares. Pesaran et al. (2000) shows that the above model can be transformed to a vector error-correction model given as follows:

$$\Delta Z_{it} = a_{i0} + \Gamma_i \Delta Z_{it-1} + \Pi_i Z_{it-1} + e_{it}, \tag{11}$$

where, $a_{i0} = (a_{iY}, a'_{iX})'$, $\Gamma_i = (\Gamma'_{iY}, \Gamma'_{iX})'$, $\Pi_i = (\Pi'_{iY}, \Pi'_{iX})' = (\Pi'_{iY}, \mathbf{0}_{2\times 3})'$, in which $\mathbf{0}_{2\times 3}$ is a 2×3 matrix of zeros. In addition, Pesaran et al. (2000) shows that the relationships among coefficients in (9), (10) and Eq. (11) are $c_i \equiv a_{iY} - \Lambda_i a_{iX}$, $\Psi_i \equiv \Gamma_{iY} - \Lambda_i \Gamma_{iX}$. In other words, one can solve for a_{iY} and Γ_{iY} given the estimates of Λ_i, c_i, a_{iX}, Γ_{iX} and Ψ_i from Eqs. (9) and (10), which in turn allows us to construct coefficient matrices of a_{i0}, Γ_i and Π_i in Eq. (11).

Having the VECM of Eq. (11), Pesaran and Shin (1996, 1998) shows that one can transform it to a VAR(p) model for Z_{it}

$$Z_{it} = a_{i0} + \Phi_{i1} Z_{it-1} + \Phi_{i2} Z_{it-2} + \varepsilon_{it},$$

where $\Phi_{i2} = -\Gamma_i$; $\Phi_{i1} = I_3 + \Pi_i + \Gamma_i$, in which I_3 is an identity matrix of size 3. We can then transform the above VAR process to a vector moving average process:

$$Z_{it} = b + \sum_{j=0}^{\infty} A_{ij} \varepsilon_{it-j},$$

where, $b = (-\Pi_i)^{-1} a_{i0}$, $A_{ij} = \Phi_{i1} A_{ij-1} + \Phi_{i2} A_{ij-2}$; j=1,2,… and i=1,…, N, with $A_{i0} = I_3$ and $A_{ij} = 0$ for $j < 0$. We construct the IRF of real output, credit and equity market development, respectively, based on the moving average representation of Z_{it}.

4. Empirical investigation

4.1. Data description

Following King and Levine (1993), two indicators are used to measure banking development. The first is financial depth (LLY) measured by the ratio of liquid liabilities of the financial system to gross domestic product (GDP), which measures the size of the financial intermediary. Liquid liabilities of the financial system are measured by M3, which is Line 551 from International Financial Statistic (IFS). However, when Line 551 is not available, we use M2, the sum of Line 34 and Line 35, to measure liquid liabilities. The second, denoted by BANK, is the ratio of deposit money banks' domestic assets to the sum of domestic assets in deposit money banks and the central bank. This ratio measures the relative importance of deposit money banks versus the central bank with regard to the allocation of savings. The central bank's domestic assets are obtained by aggregating IFS lines 12a through 12f and domestic money banks' domestic assets are the summation of IFS lines 22a through 22f.

Following Levine and Zervos (1998), we construct two stock market development indicators to measure stock market development. The first indicator, denoted by SIZE, is the ratio of market value of domestic shares listed on domestic exchanges to GDP. It represents capitalization of the stock market and can also serve as an efficiency measurement. The second indicator, denoted by TOV, equals the value of the trades of domestic shares on domestic exchanges divided by the value of listed domestic shares. This indicator is related to liquidity, the ease and speed with which assets can be converted to cash.

Finally, economic development is measured by real GDP in which nominal GDP is expressed by the US dollar. The GDP deflator (year 2000 = 100) is used to construct real GDP. The logarithm of the real GDP, denoted by LRGDP, indicates economic development. The consumer price index (CPI), the GDP deflator, the nominal gross domestic product, and the nominal exchange rate are taken from IFS line 64, line 99bIPZF, line 99b, and line AF.ZF, respectively.

To avoid the stock-flow problem emphasized by King and Levine (1993), Levine et al. (2000), Calderon and Liu (2003), and Beck and Levine (2004), we make the following adjustment:

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[8] It is worth noting that ΔX_{it} is not correlated and u_{it} in Eq. (9) although it is correlated with e_{it} in Eq. (11) (Pesaran et al., 2000). In such a situation, the MLE is the same as the GMM estimator (Hamilton, 1994, p. 428).

$$\text{LLY} = \left[0.5 \times \left(\frac{\text{M3}_t}{\text{CPI}_t} + \frac{\text{M3}_{t-1}}{\text{CPI}_{t-1}}\right)\right] \Big/ \left[\frac{\text{GDP}_t}{\text{avg}(\text{CPI}_t)}\right],$$
$$\text{SIZE} = \left[0.5 \times \left(\frac{\text{MV}_t}{\text{CPI}_t} + \frac{\text{MV}_{t-1}}{\text{CPI}_{t-1}}\right)\right] \Big/ \left[\frac{\text{GDP}_t}{\text{avg}(\text{CPI}_t)}\right],$$
$$\text{TOV} = \left[\frac{\text{Value}_t}{\text{avg}(\text{CPI}_t)}\right] \Big/ \left[0.5 \times \left(\frac{\text{MV}_t}{\text{CPI}_t} + \frac{\text{MV}_{t-1}}{\text{CPI}_{t-1}}\right)\right],$$

where avg(CPI_t) is the average of CPI over t and t-1, MV_t and Value_t are stock market capitalization and total value traded at the end of year t, respectively.

The sample period starts from 1976 and ends in 2005. Thirteen countries in the EU are used in our empirical investigation: Austria, Belgium, Denmark, France, Germany, Greece, Italy, Netherlands, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. Data for financial development and economic growth are obtained from the International Financial Statistics (IFS), and data for stock market indexes are obtained from the financial structure and economic development database (FSEDD). We focus on those thirteen countries in EU since these countries are highly integrated in terms of their economies and monetary structures and hence should be discussed together.

4.2. Panel unit-root tests

Our goal is to apply PMG estimators of Pesaran et al. (1999) to examine the short- and long-run impacts of credit and stock market development on economic activity. However, pre-testing the order of integration of variables are important since the asymptotic distribution of parameter estimates depend on whether variables of interests are all $I(1)$ or $I(0)$. It is well known that controlling cross-sectional correlation across individuals is crucial in testing the unit-root hypothesis with panel data. We apply the cross-sectional dependence (CD) test, proposed by Pesaran (2004), to investigate the existence of contemporaneous correlation across agents in the panel. Results from the second column of Table 1 reveal that the average contemporaneous correlation coefficients are 0.116, 0.031, 0.504, 0.068, and 0.667 for LLY, BANK, SIZE, TOV, and LRGDP, respectively. The CD statistics reject the null hypothesis of no contemporaneous correlation among estimated residuals at the 5% level for all variables except BANK. Given the rejection of the hypothesis of no cross-sectional dependence for most variables, we apply the panel unit-root test provided by Pesaran (2007) to examine the unit-root hypothesis of the finance-growth variables. Results from the last two columns of Table 1 indicate that the unit-root hypothesis is not rejected at conventional levels for all variables based on both the CIPS and CIPS* statistics. These results support the contention that variables under investigation are all $I(1)$ variables.

4.3. Dynamic impacts of bank and stock market development on real output

The following error-correction model is estimated to uncover the long- and short-run consequences of banking and stock markets on growth:

$$\Delta \text{LRGDP}_{i,t} = \phi_i(\text{LRGDP}_{i,t-1} - \mu - \beta_1 \text{FD}_{i,t-1} - \beta_2 \text{STOCK}_{i,t-1}) + \alpha_{i1}\Delta \text{LRGDP}_{i,t-1} + \lambda_{i1}\Delta \text{FD}_{i,t} + \lambda_{i2}\Delta \text{FD}_{i,t-1} + \lambda_{i3}\Delta \text{STOCK}_{i,t} + \lambda_{i4}\Delta \text{STOCK}_{i,t-1} + \delta_{i,t}, \tag{12}$$

where LRGDP, FD, and STOCK are indicators for economic, financial, and stock market development, respectively. Following Loayza and Ranciere (2006), we impose a common lag structure across countries rather than using some consistent information criteria (e.g., Schwartz Bayesian criterion) due to the limitation of the data. The existence of a long-run relationship

Table 1
Panel unit root tests.

Tests	$\bar{\hat{\rho}}$	CD	CIPS	CIPS*
Panel A: Financial development indicators				
LLY	0.116	5.60**	−1.663	−1.663
BANK	0.031	1.49	−2.129	−2.129
Panel B: Stock market development indicators				
SIZE	0.504	24.37**	−1.281	−1.281
TOV	0.068	3.29**	−1.787	−1.787
Panel C: Economic development indicator				
LRGDP	0.677	32.75**	−1.703	−1.703

Notes: LLY is the ratio of liquid liabilities of the financial system to gross domestic product. BANK is the ratio of deposit money banks' domestic assets to the sum of domestic assets in deposit money banks and the central bank. SIZE is the ratio of market value of domestic shares listed on domestic exchanges to GDP. TOV is the value of the trades of domestic shares on domestic exchanges divided by the value of listed domestic shares. LRGDP is the logarithm of RGDP. $\bar{\hat{\rho}}$ is the average of correlation coefficients across all pairs and CD denotes cross-sectional dependence test statistics. The model used to test the unit-root hypothesis is the one with intercept and trend. CIPS, and CIPS* are panel unit-root statistics developed by Pesaran (2007). The 5% critical value of the CIPS (or CIPS*) statistic is given in Table II(c) of Pesaran (2007). '**' indicates significance at the 5% level.

among financial development, stock market development, and real output requires that the error-correction coefficient, ϕ_i, is negative (but not lower than −2). In addition, the coefficients of β_is denote corresponding long-run elasticity which are constrained to be the same across countries. The long-run impacts of banking and stock markets development on real outputs can be examined based on the significance of β_1 and β_2. Short-run impacts of financial development are observed if the lag first-differenced variables in Eq. (12) are significant.

Two different indicators are applied to proxy banking development. They are financial depth (LLY) and the ratio measuring the relative importance of deposit money banks versus the central bank (BANK). Meanwhile, stock market capitalization (SIZE) and stock market liquidity (TOV) are two indicators to measure stock market development. Given that a bank market is measured by LLY (BANK), models I and II (III and IV) refer to the models with a stock market measured by SIZE and TOV, respectively. Table 2 reports PMG estimates and specification tests of Eq. (12). The error-correction coefficient (ϕ_i) is negative and significant regardless of selected models. This indicates that there exists a long-run relationship between credit market development, stock market development and economic development irrespective of the selected stock and credit market indicators. The Hausman test fails to reject the long-run homogeneity restriction, at conventional levels of significance, regardless of the selected stock and credit market indicators supporting the appropriateness of PMG estimators.

We are also interested in examining whether the long-run coefficients in Eq. (12) are the same. More specifically, we investigate whether the long-run impacts of banking and stock market development on real output are the same ($\beta_1 = \beta_2$). The above hypothesis is examined by the likelihood ratio (LR) statistic. The LR statistic shown in Table 2 rejects equality of all long-run coefficients suggesting the distinct behavior of financial development and stock market development

Table 2
Dynamic effects of credit and stock market development on economic activity $\Delta LRGDP_{i,t} = \phi_i(LRGDP_{i,t-1} - \mu - \beta_1 FD_{i,t-1} - \beta_2 STOCK_{i,t-1}) + \alpha_{i1}\,\Delta LRGDP_{i,t-1} + \lambda_{i1}\Delta FD_{i,t} + \lambda_{i2}\,\Delta FD_{i,t-1} + \lambda_{i3}\Delta\,STOCK_{i,t} + \lambda_{i4}\Delta STOCK_{i,t-1} + \delta_{i,t}$.

	Model			
	I	II	III	IV
Long-run coefficients				
$LLY_{i,t-1}$	−0.669**	−0.519***		
	(−2.995)	(−4.215)		
$BANK_{i,t-1}$			1.046	0.340**
			(1.565)	(2.607)
$SIZE_{i,t-1}$	0.893**		0.986***	
	(3.098)		(5.517)	
$TOV_{i,t-1}$		0.280**		0.441***
		(2.966)		(4.629)
LR statistics	44.826	42.967	45.585	35.400
[*p*-value]	[0.006]	[0.010]	[0.005]	[0.063]
Joint Hausman Tests	0.46	1.09	0.28	3.74
[*p*-value]	[0.800]	[0.580]	[0.870]	[0.150]
Error-correction term	−0.087***	−0.112***	−0.090**	−0.096***
	(−3.500)	(−3.676)	(−3.118)	(−3.654)
Short-run coefficients				
$\Delta LRGDP_{i,t-1}$	0.096**	0.089	0.083	0.077
	(2.227)	(1.569)	(1.483)	(1.590)
$\Delta LLY_{i,t}$	0.113	0.059		
	(0.721)	(0.440)		
$\Delta LLY_{i,t-1}$	0.047	0.063		
	(0.472)	(0.631)		
$\Delta BANK_{i,t}$			0.674**	0.329
			(2.163)	(1.231)
$\Delta BANK_{i,t-1}$			0.184	0.208
			(0.856)	(0.981)
$\Delta SIZE_{i,t}$	0.108**		0.039	
	(2.066)		(0.703)	
$\Delta SIZE_{i,t-1}$	0.013		−0.020	
	(0.173)		(−0.441)	
$\Delta TOV_{i,t}$		−0.017		−0.012
		(−0.826)		(−0.614)
$\Delta TOV_{i,t-1}$		−0.047**		−0.075**
		(−2.413)		(−2.533)
MLL	649.942	645.994	668.175	674.471

Notes: LLY is the ratio of liquid liabilities of the financial intermediary to GDP. BANK is the ratio of deposit money banks' domestic assets to the sum of deposit money banks' domestic assets and central bank's domestic assets. LLY and BANK are two indicators for banking development (FD). SIZE is the ratio of market value of domestic shares listed on domestic exchanges to GDP. TOV is the value of the trades of domestic shares on domestic exchanges divided by the value of listed domestic shares. SIZE and TOV are two indicators for stock market development (STOCK). LRGDP is the logarithm of real GDP. Short-run coefficient estimates and the error-correction coefficient estimate reported in the Table are mean group estimates. LR is the likelihood ratio statistic testing the hypothesis that long-run coefficients in Eq. (12) are the same ($\beta_1 = \beta_2$). MLL is the maximized log likelihood statistic testing the hypothesis that the coefficients of the model are all the same. Numbers in parentheses are *t*-statistics. '***', '**', and '*' indicate significance at the 1%, 5%, and 10% levels, respectively.

on economic development. In other words, although both banking and stock markets are part of the entire financial system, they provide different services and have different impacts on economic development. Finally, we apply the maximized log likelihood statistic (MLL) to examine the hypothesis that long- and short-run coefficients of the model are all the same.[9] The MLL statistic reported in the last row of Table 2 rejects the null hypothesis at conventional levels.

Results from models I and II of Table 2 indicate a negative long-run impact of financial depth on real output. The average impact (or multiplier) of financial depth on growth is −0.058 ($-\hat{\phi}_i\hat{\beta}_1$) based on model I.[10] This indicates that a deepening of financial markets of European countries by 1% will impede their average GDP growth by 0.058%. Our findings support theoretical implications of negative impacts of financial development on growth in literature (e.g., McKinnon, 1973; Shaw, 1973; Roubini and Sala-i-Martin, 1992; Bencivenga et al., 1995). Our results are consistent with the results of Ram (1999) who found a negligible or negative association between financial depth and economic growth based on 95 individual countries.

Results from models III and IV indicate a positive long-term influence of BANK on economic development, suggesting that financial development is a key channel through which financial intermediation enhances growth. The multiplier of BANK on real GDP growth is 0.033 ($-\hat{\phi}_i\hat{\beta}_1$) based on model IV.[11] Our finding of a positive association between financial intermediation and economic development is consistent with that of King and Levine (1993), Levine et al. (2000), and Rioja and Valev (2004).

It is interesting to find that the long-run impact of LLY on real output is in contrast to that of BANK. As mentioned previously, LLY and BANK capture different financial services offered by financial intermediations. The former is linked with the magnitude and the efficiency of loans, and the latter is related to the risk diversification and information services of commercial banks relative to the central bank (King and Levine, 1993). There are two aspects to explain why the impact of financial depth on growth is negative. First, credit markets provide loans for investment which in turn promote economic development. The growth mechanism will operate smoothly only if loans are properly monitored (Singh, 1997). Otherwise, it will lead to loan loss and financial crisis, which in turn harms the real economic activity. Second, several studies have argued that if the saving rate rises with the rate of interest, then capital market imperfections may lower growth by depressing savings (McKinnon, 1973; Shaw, 1973).

Still other literature indicates that financial repression, capital market imperfections such as lack of competition, and poor regulatory environment of financial liberalization can lower growth (Roubini and Sala-i-Martin, 1992; Pagano, 1993 and De Gregorio and Guidotti, 1995). Our findings of a negative impact of financial depth on real output support the negative side of financial depth in the EU. Thereby, relative to deepening their financial markets, improving risk diversification and information services, i.e., BANK, is more crucial for EU countries to ameliorate economic development.

The long-run effects of stock market capitalization and liquidity on economic development are both positive and significant. The average impact of SIZE on real GDP growth is between 0.078 and 0.089 ($-\hat{\phi}_i\hat{\beta}_2$) based on models I and III, respectively, and the average multiplier of TOV on real GDP growth is between 0.031 and 0.042. These results point out that stock markets are important in the process of the finance-growth nexus, which is also in line with other findings (Atje and Jovanovic, 1993; Levine and Zervos, 1998; Rousseau and Wachtel, 2000; Beck and Levine, 2004).

Finally, we analyze the average short-run effect of banking by constructing the mean of corresponding coefficients across 13 EU countries since short-run coefficients are allowed to vary across countries. Short-run effects are observed if the lag first-differenced variables in Eq. (12) are significant. Several interesting results are observed from the lower panel of Table 2. First, banking development has no short-run effect on growth irrespective of the indicator of credit market development being LLY or BANK. These results accompany the result wherein financial development leads to long-run economic development implying that the development of financial intermediation is indeed a long-term policy, which is consistent with the views of Christopoulos and Tsionas (2004). Second, stock market liquidity has negative instead of positive short-run effects on growth. An increase in liquidity of equity markets increases the return to investment and decreases the demand for precautionary savings, which in turn decreases saving (Arestis et al., 2001; Rousseau and Wachtel, 2000). In addition, high stock market liquidity encourages myopia based on the view of cooperative control. The easy sale of equity discourages efforts on cooperative management, which in turn hurts economic growth (Jensen and Murphy, 1990). Our results support the above arguments.

Why is the short-run effect of stock market development on real output opposite to its long-run impact? Gaytan and Ranciere (2003) indicates that financial institutions have to face the trade-off between insuring against crises and less money available for investment. Facing financial crises, financial institutions without full insurance to cover bank run's risk will experience credit volatility and low output growth in the short term. In the long term, financial institutions would be free from crises and would render stable growth. Wynne (2002) and Dell'Ariccia and Marquez (2004, 2006) argue that financial liberalization is always linked with a speculative bubble, excessive liquidity, financial crises, volatility and low growth in the short run. In contrast, financial liberalization results in higher and more stable productivity growth in the long run.

Several theoretical models predict a positive long-run but negative short-run relationship between financial intermediations and economic development (Rajan, 1994; Gaytan and Ranciere, 2003; Dell'Ariccia and Marquez, 2004; Dell'Ariccia and Marquez, 2006). Our empirical results from Table 2 support the theoretical implication of these previous studies.

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[9] To be specific, the null hypothesis of MML test is $\beta_1 = \beta_2 = \alpha_{MG,1} = \lambda_{MG,1} = \lambda_{MG,2} = \lambda_{MG,3} = \lambda_{MG,4}$.

[10] Since we report mean group estimators in Table 1 and hence the constructed number is the average impact.

[11] We use the estimates from model IV, instead of model III, to construct the multiplier of BANK on real GDP growth since the estimate of β_1 in model III is insignificant.

Table 3
Root-mean-square errors of the PMG model and the random walk.

Country	Model II		Model IV		RWD
	Model A	Model B	Model A	Model B	
Austria	**0.0376**	**0.0371**	**0.0428**	**0.0426**	0.0453
Belgium	0.0423	0.0404	**0.0253**	**0.0274**	0.0314
Denmark	0.0428	0.0328	0.1270	0.1271	0.0212
France	0.3546	0.3580	0.1531	0.1548	0.0220
Germany	0.0592	0.0886	**0.0398**	**0.0411**	0.0532
Greece	**0.1704**	**0.1736**	0.2052	**0.1883**	0.1948
Italy	0.0348	0.0354	0.0477	0.0517	0.0332
Netherlands	0.0730	0.0997	0.0667	0.0889	0.0401
Portugal	**0.0429**	0.0595	**0.0436**	0.0501	0.0474
Spain	0.0531	0.0480	0.0736	0.0722	0.0255
Sweden	0.0581	0.0624	0.0746	0.0822	0.0536
Switzerland	0.0860	0.1001	0.0716	0.0711	0.0702
United Kingdom	0.0930	0.0947	0.0774	0.0783	0.0744

Notes: Model II (IV) is the PMG model of Eq. (12) with LLY (BANK) and TOV measuring credit and stock market development, respectively. Model A indicates the system equations of (10) and (12). Forecasts of real output from model A are therefore ex-ante forecasts. Model B is the PMG model of Eq. (12) and forecasts of real output from model B are ex-post forecasts. RWD indicates the model of random walk with drift. Boldface values indicate that the model out-predicts the random walk in out-of-sample contests.

4.4. Out-of-sample tests of the PMG model

Given that the PMG model is supported based on our estimation results in Table 2, it is interesting to ask whether the model performs well in predicting real output in out-of-sample contests. We therefore investigated the out-of-sample predictability of the PMG model relative to that of the random walk with drift. To be specific, we constructed the root-mean-square error from the PMG model and the random walk with drift, respectively, based on recursive regressions for each country. We preserved the first twenty observations as the initial estimation period since we have only thirty observations. After estimating both models, we constructed one-period-ahead forecasts of real output. We then added one observation to the sample and re-estimated the model to obtain new estimates and then constructed a one-period-ahead forecast based on new estimates. Repeating the previous procedure until the observation before the last observation was added to the sample. We therefore have 10 one-period out-of-sample forecasts of real output for each country, which allowed us to construct the root-mean-square error of real output forecasts.

It is worth noting that regressors in Eq. (12) include the current changes of credit and equity development. To obtain one-period-ahead ex-ante output forecasts, we need to have one-period-ahead forecasts of credit and equity development. We therefore assume that both credit and equity developments follow a differenced VAR as in Eq. (10). We then use the system Eqs. (12) and (10) to construct ex-ante forecasts of real output. Although Eq. (12) alone does not allow us to construct ex-ante forecasts of real output, it allows us to construct ex-post forecasts of real output. In this case, one-period-ahead forecasts of credit and equity development are replaced by their actual values.

Table 3 reports the RMSE of output forecasts from models II and IV, and the random walk with drift, respectively.[12] The measure of financial development and stock market development in model II (IV) are LLY (BANK) and TOV. Model A indicates the system equations of (12) and (10) which allows us to construct ex-ante forecasts but model B indicates Eq. (12) allowing us to construct ex-post forecasts only. Table 3 reports out-of-sample contests of different models and we claim that the PMG model out-predicts the random walk with drift if its RMSE is smaller. Results from Table 3 indicate that PMG models do not out-predict random walks for most countries in European Union. Model II (IV) out-predicts the random walk in three (four) out of thirteen countries.[13]

Do our results invalidate the PMG model? We argue that it is premature to make such a conclusion. First, there is a trade-off between the sample size of in-sample estimation and out-of-sample prediction. The trade-off is extremely difficult especially when we have only 30 observations for each country. If we allow for reasonable sample size for in-sample estimation then the sample size for out-of-sample prediction is small. This affects the accuracy of the out-of-sample comparison. On the other hand, if we allow for reasonable sample size for out-of-sample comparison, then the sample size for initial estimation will be very small affecting the efficiency of parameter estimates. Second, real output depends on capital stocks, which in turn depends on the investment decision of firms. Since investment is affected by the expectation of current and future fundamentals. Therefore, predicting real output based on current fundamentals may not be appropriate since they have little

[12] Results from Table 3 are not affected significantly if models I and III are applied in out-of-sample contests. These results are not reported here but are available upon request from authors.

[13] This paper also plots ex-ante forecasts and actual values of the de-meaned output growth, ΔY_{it}, over the forecast periods for models II and IV. We find that predicted values fit the trend of actual value well but are more volatile than actual values in general. In addition, predicted values fit most of turning points of actual values in half of the countries under investigation. These figures are not reported in the paper but are available upon request from authors.

weight in determining output. In such a case, it is too restrictive to evaluate the validity of a model based on out-of-sample tests (Engel and West, 2005).

4.5. Impulse response analysis

It is interesting to discuss the impacts of different shocks on real GDP, bank and stock market development. There are too many IRFs since we have four different models and the panel includes 13 countries for each model. We, therefore, report the IRFs of Germany and the United Kingdom for all four different models in Figs. 1 and 2 for practical reasons. The IRFs for other countries are not reported here, but they are available upon request from authors. In constructing the IRF for different countries, the long-run cointegrating coefficients in (9) are assumed to be the same since the homogeneous restriction on long-run coefficients are not rejected by data. We allow country-specific intercepts, error-correction coefficients, and short-run coefficients in Eqs. (9) and (10).

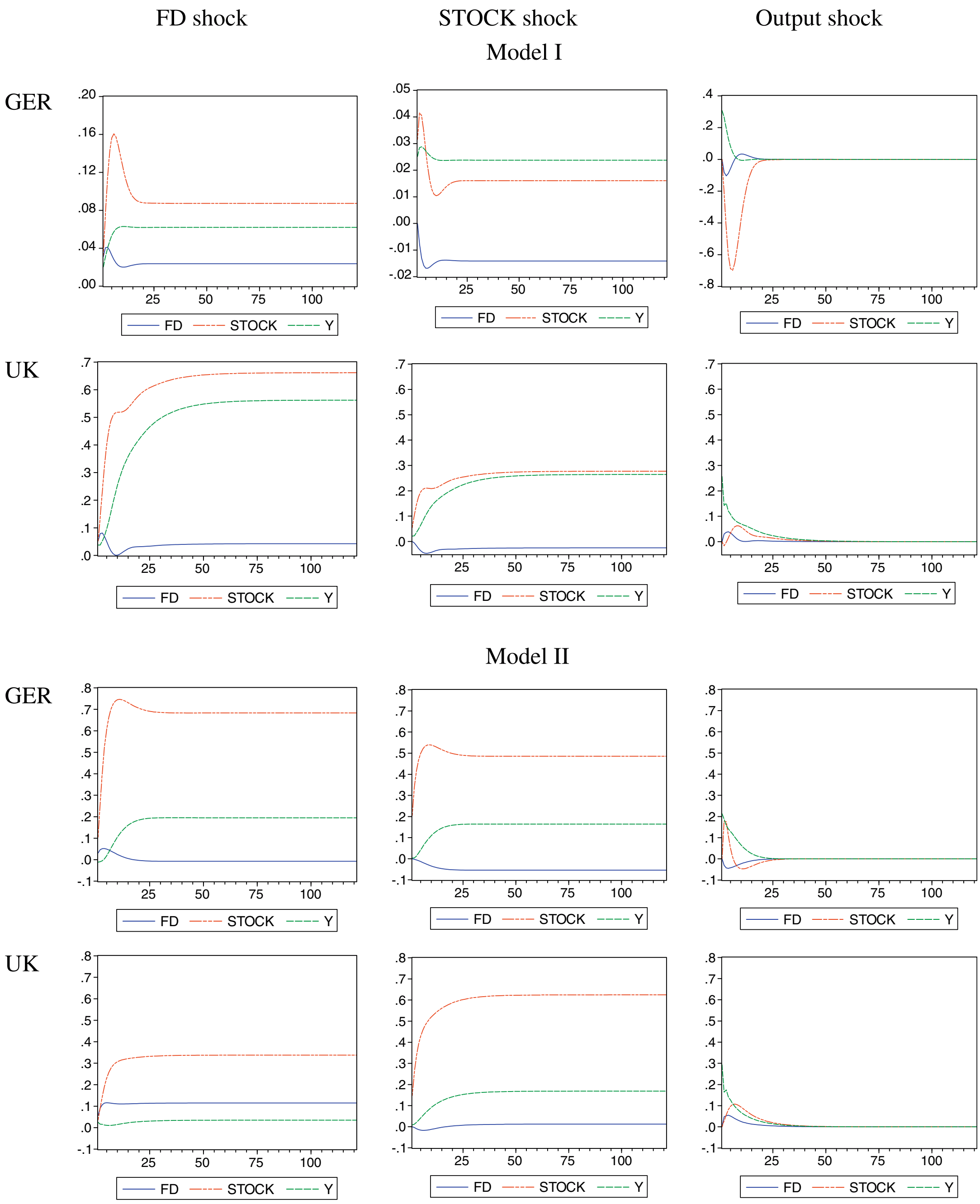

Fig. 1. Impulse response functions of shocks for models I and II. *Notes:* FD denotes financial development, STOCK represents stock market development, and *Y* is real output. The measure of financial development is LLY for both models, but the measure of stock development is SIZE in model I and TOV in model II.

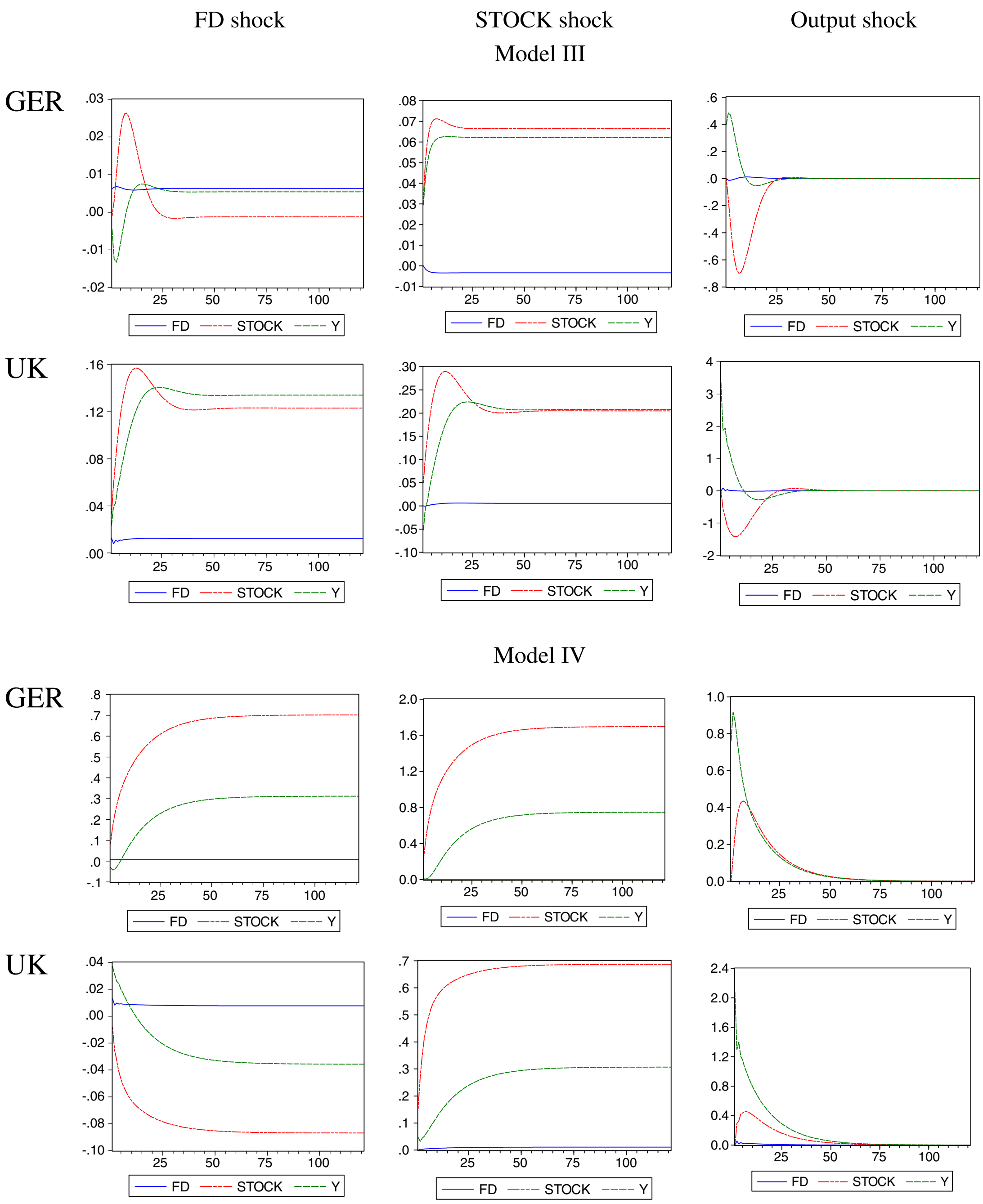

Fig. 2. Impulse response functions of shocks for models III and IV. Notes: FD denotes financial development, STOCK represents stock market development, and *Y* is real output. The measure of financial development is BANK for both models, but the measure of stock development is SIZE in model III and TOV in model IV.

Fig. 1 shows the IRF functions of Germany (GER) and the United Kingdom (UK) for models I and II. The measure of financial development is LLY for both models, but the measure of stock market development is SIZE in model I and TOV in model II. For the case of GER, a positive shock on bank (equity) development increases output in both short and long run. However, a positive output shock decreases financial development in the short run but have only negligible impact in the long run. A positive equity development shock decreases bank development but a positive bank development shock increases equity development. As for the case of UK, the impacts of bank and equity development shock on the economy are similar to those in GER. Although the long-run impacts of a positive output shock on the economy are negligible, its impacts on bank and equity markets are positive in the short run, which are in contrast to those in GER. In short, when bank development is measured by LLY, impulse responses from models I and II are similar for both countries regardless of the measure of stock market development.

Fig. 2 reports the IRF of GER and UK for models III and IV. The measure of financial development is BANK for both models, but the measure of stock market development is SIZE in model III and TOV in model IV. The long-run impacts of bank development shocks on output and equity development are positive for the UK but negligible for GER. The long-run impacts of equity development shocks on output are positive but they have negligible impacts on bank development for both countries. As for the output shock, it has a short-run negative but long-run negligible effect on equity development for both countries. Finally, the impulse responses from model IV for both countries are similar to those from model III. The only exception is that bank development shocks have negative short- and long-run effects on output and equity development, for UK, but the magnitude of those impacts is small.

In short, the long-run effect of a bank (equity) development shock is positive, but its short-run effect on output is ambiguous. A bank development shock has positive impacts on equity development but an equity development shock has negative impacts on bank development in general.

Our results are coherent with the current episode of global financial crisis. The partial collapse of the banking industry, starting from the bankrupt of Fannie Mae and Freddie Mac, suggests a negative shock from credit market. The negative shock cause the stock market crashed by 50% and decrease the growth of GDP around 0.9%,[14] consistent with our result that a negative shock on bank industry deteriorates stock market development and decreases output.

5. Concluding remarks

The purpose of this study is to examine the dynamic impact of financial institutions on economic development. Conventional literature examines this issue without considering the role of stock markets. The key innovation of our study is the incorporation of both banking and stock market variables to examine the long-run relationship among both markets and economic development and to investigate the short-run effects of both markets on economic growth. Based on data from 13 EU countries over 1976–2005, we found several interesting results. First, there exists a long-run equilibrium relationship among banking market development, stock market development and economic development, and stock market capitalization and liquidity have positive long-run effects on economic development. Second, although deepening financial markets (LLY) may impede long-run real output, improving risk diversification and information services of commercial banks (BANK) can render stable economic development. Our findings suggest helpful long-run financial development policy for EU countries. Finally, stock market liquidity has a short-term negative impact on economic growth. Findings of a positive long-run consequence but a short-term negative effect between liquidity and economic development support theoretical implications cited by Wynne (2002) and Dell'Ariccia and Marquez (2004, 2006).

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